Safety of Carotid Endarterectomy in a High-Risk Population: Lessons from the VA and Connecticut

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BACKGROUND: The safety and efficacy of carotid endarterectomy (CEA) have been demonstrated in randomized trials, but these studies excluded patients thought to be at higher risk for poor outcomes. We sought to determine whether patients undergoing CEA in Veteran Affairs Hospitals (VA) were at higher risk and had different outcomes, compared with patients in nonfederal hospitals.

STUDY DESIGN: Records of all CEA performed in the VA Connecticut Healthcare System between October 1997 and September 2002 were examined and compared with CEA performed in all nonfederal Connecticut hospitals (CT).

RESULTS: There were 7,089 CEAs performed (VA, 140; CT, 6,949). VA patients had increased comorbidity scores and symptomatic presentation (39% versus 14%; $p < 0.0001$). Perioperative mortality rates were 1.4% (VA) and 0.3% (CT) ($p = 0.06$). Perioperative stroke (VA, 1.4% versus CT, 0.9%; $p = 0.15$) and cardiac complication (VA, 2.9% versus CT, 2.1%; $p = 0.54$) rates were similar. Multivariate analysis demonstrated that perioperative mortality correlated with symptomatic presentation (odds ratio 11.7, $p < 0.0001$), but not performance, in a VA hospital ($p = 0.23$); patients treated at the VA were also not at higher risk for stroke ($p = 0.94$) or cardiac complications ($p = 0.90$).

CONCLUSIONS: Despite increased severity of illness and symptomatic presentation, VA patients had similar perioperative outcomes compared with patients undergoing CEA in nonfederal hospitals in the state of Connecticut. These results suggest not only that patients undergoing vascular surgery at the VA may form a higher-risk population compared with patients receiving care in non-VA hospitals, but that these high-risk patients can undergo CEA safely. (J Am Coll Surg 2006;203: 277–282. © 2006 by the American College of Surgeons)

The safety and efficacy of carotid endarterectomy (CEA) have been demonstrated in large randomized clinical trials,[1,2] but these trials excluded patients thought to have increased risk and confounding causes of postoperative stroke. These exclusions have called into question the safety of CEA in high-risk patients and have stimulated investigation into the definition and management of these patients with carotid stenosis. In addition, they have led some to propose management of high-risk patients with carotid angioplasty and stenting (CAS) rather than CEA.[3] Medical conditions such as congestive heart failure, recent myocardial infarction or ischemia, renal disease, or pulmonary disease, and anatomic factors such as earlier surgery or radiation therapy are thought to place certain patients at a higher risk for traditional repair with CEA. The severity of the medical conditions that could potentially tip the balance in favor of CAS is currently being investigated, but there is question as to whether the simple presence of these conditions increases risk.

Patients seeking care at Veteran Affairs Hospitals (VA), for reasons that have not been well documented, are commonly thought to possess higher rates of comorbidity than the general population. To determine whether patients presenting for CEA in VA hospitals have higher comorbidity compared with the general population, we analyzed all CEA performed in the state, including federal and nonfederal hospitals. In particular, we analyzed risk factors thought to increase the periop-

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Abbreviations and Acronyms

ASA = American Society of Anesthesiologists
CAS = carotid angioplasty and stenting
CEA = carotid endarterectomy
CT = Connecticut
NSQIP = National Surgical Quality Improvement Program
TIA = transient ischemic attack
VA = Veteran Affairs Hospital

erative risk of CEA and compared these factors in patients having surgery at the VA to those in hospitals in the remainder of the state of Connecticut.

METHODS

All CEAs performed from October 1997 to September 2002 in the state of Connecticut were identified by examining the databases of the Connecticut VA and the Connecticut Hospital Association. The Connecticut VA database is derived from internal data submitted to the Veterans Health Administration's National Surgical Quality Improvement Program (NSQIP). This study was approved by the VA Institutional Review Board.

The VA data were examined for comorbid conditions, complexity scores, and perioperative outcomes on all patients undergoing CEA at the VA Connecticut Healthcare System, West Haven, CT. The West Haven VA was the only VA performing CEAs in the state of Connecticut during the time of the study. The vascular surgeons staffing the VA Connecticut Healthcare System are on the faculty of the Yale University School of Medicine and perform operations in both institutions; operations performed by these faculty members outside of the VA were recorded in the Connecticut database. All data from the VA were verified by individual chart review to ensure accuracy, and no discrepancies between the medical records and the NSQIP data were noted with respect to perioperative complications or mortality.

A database of patient discharge records from acute care, nonfederal Connecticut hospitals is maintained by Chime, Inc (www.cthosp.org). The Connecticut Hospital Association Chime Data Program maintains a proprietary health-care information system dating back to 1980 that incorporates statewide clinical, financial, and patient demographic data. Reports containing select variables are available on a fee-for-service basis. A previously verified and published algorithm was used to select CEA procedures from the Chime database.[4] In brief, discharge records were selected if they contained the diagnosis-related group (DRG) 5 (extracranial vascular procedures), the International Classification of Diseases (ICD)-9-CM principal procedure code of 38.12 (head/neck endarterectomy), and the ICD-9-CM principal diagnosis code of 433.xx (occlusion and stenosis of precerebral arteries). Accuracy of the records in the database has been verified.[5] Demographic variables for each patient record analyzed included age; gender; hypertension (diagnostic codes 401 to 405); diabetes (diagnostic code 250); heart disease (diagnostic codes 391, 394 to 398, 402, 404, 411 to 414, 416, or 425); chronic obstructive pulmonary disease (COPD; diagnostic codes 415.0, 416.8 to 416.9, 491 to 494, or 496); renal disease (diagnostic codes 582 to 583, 585 to 588, V42.0, V45.1, V56); transient ischemic attack (TIA; diagnostic codes 435, 437.1, or 781.4), amaurosis fugax (diagnostic codes 362.34 or 368.12); and complexity score.

The complexity score in the VA database is recorded as the American Society of Anesthesiologists (ASA) physical status score, in which patient diagnoses are used to assess overall patient comorbidity and predict mortality; it is graded 1 through 5. The complexity score in the Chime database is recorded as the All Patient Refined DRG: 3M Severity Adjusted Group: patient classification scheme, version 15, Risk Mortality subclass variable. This variable considers patient primary and secondary diagnoses to assess overall patient comorbidity and predict mortality and morbidity; it is graded 1 through 4. To allow a more comparable analysis between groups, a third complexity score was created using a subset of the Charlson Index.[6] This index, designed to calculate a complexity score from comorbidities identified by ICD-9 codes in databases, was calculated from variables in the index that are in both databases. Because complexity scores are derived from underlying risk factors otherwise included in the logistic regression, complexity scores were omitted from the multivariable analysis.

Patients were considered asymptomatic if there was no history of stroke, transient ischemic attack, or amaurosis fugax recorded. Outcomes studied included in-hospital mortality, perioperative stroke (diagnostic code 997.0: nervous system complications: iatrogenic cerebrovascular infarction or hemorrhage), and perioperative cardiac complications (diagnostic code 997.1: cardiac arrest, insufficiency, cardiorespiratory failure, heart